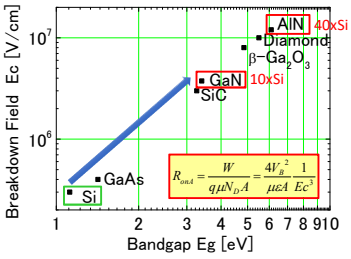
Development of Sustainable, Smart, Secure and Safe Society by Comprehensive Research and Development of Gallium Nitride (GaN)

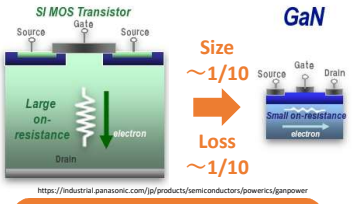
Center for Integrated Research of Future Electronics, Institute of Materials and Systems for Sustainability, Nagoya University
Shugo Nitta, Maki Kushimoto, Manato Deki, Atsushi Tanaka, Yoshio Honda, and Hiroshi Amano

Why GaN?

GaN-based LED lightings

GaN-based Power transistors

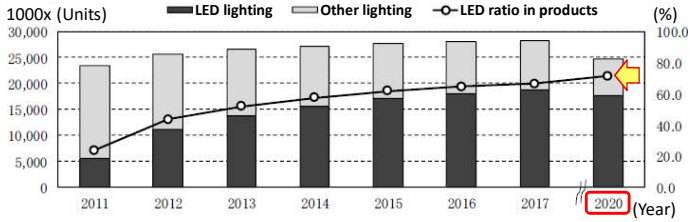




GaN power devices are; Small, Compact, Light, Efficient, Stable, Fast.

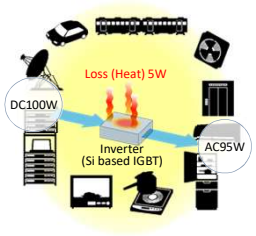
*1 Bandgap energy E_g: An energy range in a solid where no electron states can exist.
*2 Breakdown field strength E_c: High E_c material is robust to high voltage.

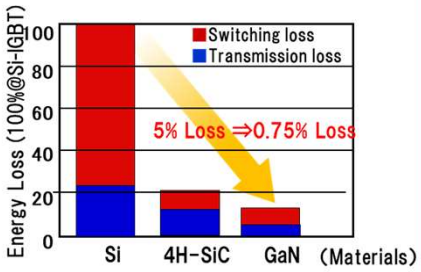
Energy savings by GaN



In Japan, we can reduce total electricity consumption by about 7% (=1,000,000,000,000 JPY) by 2020.

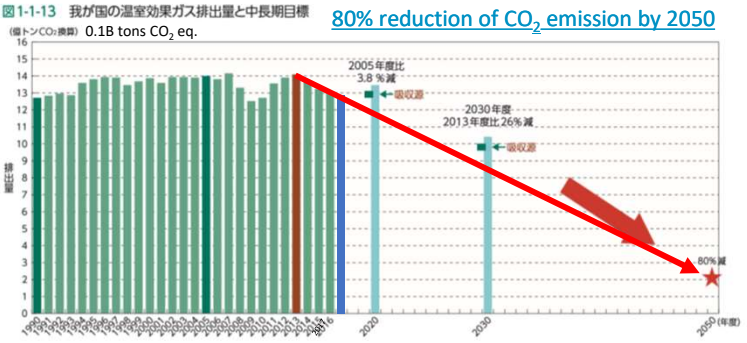
Role of Power Devices





We can reduce total electricity consumption by 9.8% by replacing Si-based transistors to GaN-based transistors!

How to realize zero emission toward 2℃/1.5℃ targets?



80% reduction of CO_2 emission by 2050

Kaya identity

By 2050 0.74x 1.5x 0.6x 0.3x = 0.2

$$F = P \times \frac{G}{P} \times \frac{E}{G} \times \frac{F}{E}$$

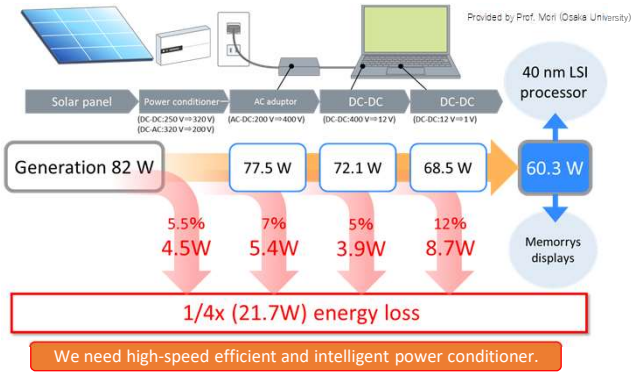
Professor Yoichi Kaya
© 2019 Club of Rome

- F is global CO_2 emissions from human sources
- P is global population
- G is world GDP
- E is global energy consumption
- G/P is the GDP per capita
- E/G is the energy intensity of the GDP
- F/E is the carbon footprint of energy

Increasing energy transmitting and conversion efficiency (decreasing energy loss) is the priority task by which method we generate energy.

Y. Kaya and K. Yokobori, Environment, energy, and economy: Strategies for sustainability, United Nations University Press, The United Nations University, 1997.

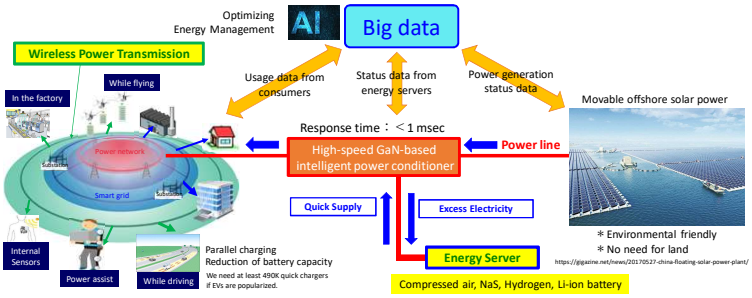
Total loss of power conversion system



We need high-speed efficient and intelligent power conditioner.

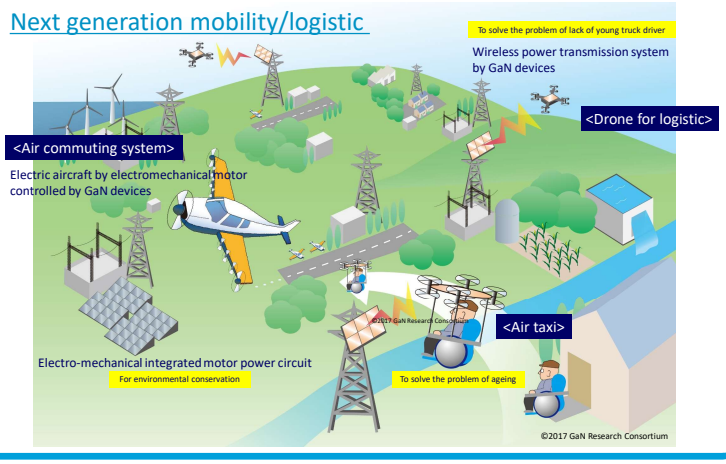
Sustainable, smart, secure and safe society by GaN

Intelligent power supply network / Internet of Energy (IoE)



Optimization of energy management by A.I. is possible by high-speed intelligent power conditioner.

Next generation mobility/logistic



Acknowledgements

MEXT Program for Research and Development of Next-Generation Semiconductor to Realize Energy-Saving Society

The Ministry of the Environment "Project of Technical Innovation to Create a Future Ideal Society and Lifestyle"

Ministry of the Environment Government of Japan